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IoT based Water Flood Detection and Early Warning System

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Abstract— Water flood is the severe and dangerous issue in public. Water flood occurs due to many factors such as heavy rain which causes critical situations. Hence, it is important to investigate water flood in different water bodies like river, sea, ocean etc. This paper proposes water flood detection algorithm in the river with the help of Internet of Things (IoT) technology. At first, a Water Level Detection Sensor, Temperature Sensor and Humidity Sensor are placed near the river to detect the flood in water bodies. The water level detection sensor acts a transmitting unit which is used to detect the water level at the time of the floods. Temperature Sensor and Humidity Sensor are used for measure the live temperature and humidity of the water bodies. Finally the collected information (data) from the water body is transmitted to LCD in order to display on the screen for the end user. When the water level increases certain level in the water body, the sensor detects and sends an alert message (SMS) to the peoples who are nearby the water body. The collected information (data) from the water level sensor and temperature and humidity sensor passed to Thingview Android application in order to find the flow graph level of the water level in the river and temperature, humidity values and sends SMS to the registered contact mobile numbers.

Keywords— IoT; Humidity; Temperature; Water Level; SMS, Sensors.

I. INTRODUCTION

Internet of Technology (IoT) based "Water Flood Detection and Early Warning System" is an intelligent technology which works with the help of internet. IoT technology plays a major role in our daily life and changes the life style of the people in a systematic way. In real life scenario, IoT technology reduces the man power to execute some critical task; with the help of sensors many real time problems can be solved. Natural Disaster management system keeps close watch over various natural factors such as water flood, forest fire etc. to predict a flood and to minimise the damage caused by the flood. This paper considers natural disaster namely water flood which leads to property damage and loss of living things and human life. In order to prevent the impacts of the water flood, the proposed system in this paper uses various natural factors to detect water flood. The proposed system uses Wifi connectivity to collect data and to access data from anywhere easily using IoT technology [1].

To detect a water flood, the proposed system monitors various natural factors related to water such as humidity, temperature, water level and flow level. These are all main features to detect water flood in different water bodies. This system uses HC-SR04 Ultrasonic Range Finder Distance Sensor which works on the principle of SONAR. This sensor is designed to measure the distance of an object from the sensor using ultrasonic wave [2]. All the sensors are connected to Arduino UNO to process and to save data.

IoT based River flood monitoring system is a complex problem of maximum social relevance in densely populated areas. Flash floods are becoming more and more dangerous every year due to an increase of rapid and extreme rainfalls events induced by climate changes the rivers flooded twice in twenty days. The compl**e**xity of the problem originates *from* the diversity of the territory involved in the monitoring process in regions like relatively far mountains (or plain regions) generally scarcely populated to densely populated urban areas traversed by streams often flowing underground. Environmental monitoring is classified at the 14th position among the Top 50 'Internet of Things' (IoT) applications for a Smarter. In addition to these features, IoT often provides interfaces for data streaming management in real-time, back end for data analysis and visualization. So that it is help for both Government and Public peoples [3] [4].

In order to develop a real-time water flood monitoring system, the proposed IoT based technique monitors the changes of water level in the river to send an alert SMS message to user through Global System for Mobile Communication (GSM) cellular network. Whenever the sensor detects heavy flood immediately sends an alert message also display the current temperature and humidity level of the water. Buzzer alarm message particularly to the

municipalities near River indicates the water flood in the surrounding area.

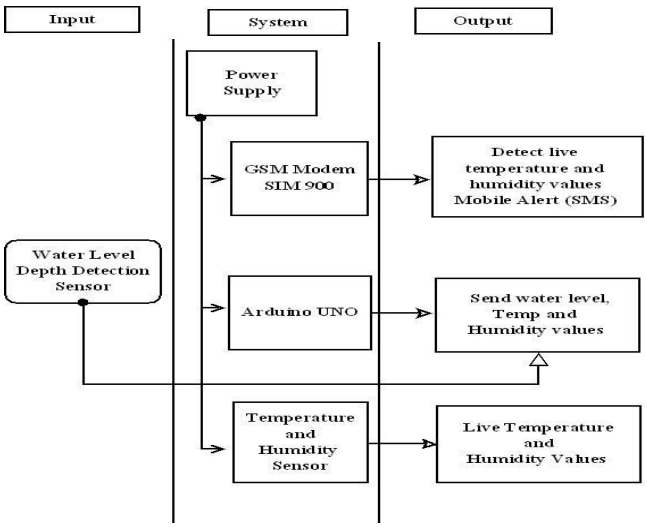

Figure 1. Block Diagram of Water Flood Detection Method

Figure 1 denotes the overall structure and working flow of the proposed method in this paper. This block diagram shows that the input to the proposed algorithm is taken from the water level sensor fixed near the water body. The system performs the operations (detecting the water level) and sends an alert message as an output to the peoples. Finally the level of the outcome of the proposed algorithm is shown as a flow graph of each values send by the sensor that will be viewed with the help of Thingview application.
Flood disaster usually happens due to sudden changes in the earth and the atmosphere. Water flood occurs due to improper irrigation method in a housing area or the sudden increase of water level in the river. Water Flood disaster causes loss of property which damages the life. Since this disaster is considered dangerous to human life, an efficient countermeasure or alert system must be implemented in order to notify people in the early stage so that safety precautions can be taken to avoid any mishaps.

This paper proposes architecture for an early warning floods system to alert public against flood disasters. This project focuses on monitoring water level remotely using wireless sensor network. The proposed method also utilizes Global System for Mobile communication (GSM), Internet of Things (IoT) and Short Message Service (SMS) to relay data from sensors to computers or directly alert the respective victim's through their mobile phone. It is hope that the proposed architecture can be further develop into a functioning system, which would be beneficial to the community and act as a precautionary action to save lives in the case of flood disaster [5].

The proposed algorithm in this paper uses an Arduino Microcontroller ATmega 328, Water Level Detection Sensor, Temperature and Humidity Sensor, GSM Module, Thingsview Android application and SMS early warning system. This proposed method is important for the people those who are nearby the water bodies for safety and welfare of the society.

II. RELATED WORK

Water Flooding is one of the major disasters occurring in various parts of the world. It is important to monitor the water level variations in rivers, dams, reservoirs etc. In paper [6]. Wireless Sensor Network (WSN) used to monitor flood conditions in the river. This method also be used for real-time monitoring of water conditions like water flow level and precipitation levels.

Reservoir is the best infrastructures to save the water resources and plays a major role in flood control. Flood Limiting Water Level (FLWL) is an effective and value approach to provide safeguards to the people from water flood caused suddenly by nature. The proposed system sends as an alert to people when the water level increases from the normal capacity. Advanced sensors are used to identify the level of water accumulated in dams, lakes and heavy water storage areas which are capable of operating without human intervention at any time regardless of the location being installed [7].

Predictive environmental sensor networks provide complex engineering and systems challenges. These systems must withstand the event of interest, remain functional over long time periods when no events occurs that covers large geographical Regions of Interest (RoI) to the event and support variety of sensor types needed to detect the phenomenon. Prediction of the phenomenon on the network itself complicates the system further which require additional computation on the microcontrollers and utilizing prediction models that are not typically designed for sensor networks [8].

IoT is the latest rapidly growing technology which brings to a new approach such as disaster monitoring. Disaster monitoring technique proposed in monitors the natural disaster activity that the people not able to do in 24 hours. This system will monitor the potential drainage usually occur flooding and share the information in real time to the people those who are in nearby water bodies [9].

Water Flood occurs when water overflows from different water bodies like river, lake or due to heavy rainfall. Flooding can be very dangerous, when floods happen in an area that people live, the water carries along objects like houses, cars, furniture and even people. It can wipe away property, trees and many more heavy items which causes heavy flow of traffic on the roads. In rainy seasons, the motorists and computers are getting stuck in a flooded areas and getting lost in finding possible routes just to go to their destinations in the correct also difficult to spread the message or to communicate with other. Hence, in order to overcome this problem the “Arduino Flood Detector System” is developed to overcome this problem. It was invented based on problem faced by motorists and

commuters when water flood occurs. This will help to avoid the traffic jam since the users have a time to find possible routes before going to be stuck in the flooded area [10][11].

The internet of things (IOT) provides the ability for human and machines to interact from billions of things that include sensors, services or other internet connected things which makes the world as "Smart World". Internet of Things technology for urban flooding prevention management system discusses the demand and overall design of urban flooding prevention management system. The application process of the internet of things technology in flooding prevention management system is summarized in [12].

IOT technology brings new approaches such as disaster monitoring. Water flood disaster is the main concern since it can happen every year during the rainy seasons. In [13], water flood detection method monitors an activity that people are not able to do it in 24 hours and sends an alert message with the help of Android Application.

The headway of flood early warning technology has grown rapidly. The technology has led to improvements in terms of communication and information. Internet of Things Technology (IoTs) has greatly influenced the development of early warning information systems. In this article a prototype of flood monitoring system based on Google Maps has been designed by integrating ultrasonic sensors as a height detector, Arduino Uno as a processor, U-Blox Neo 6m GPS module and GSM module as the sender of water level and the coordinates to the flooded information system station. The design of the prototype produces flood altitude information along with its location based on Google Maps interface [14] [15].

III. PROPOSED METHOD

This paper proposes a prototype that will detect the current water level, Live temperature and Humidity across the watershed of River and its surrounding areas with the help of Water Level Detection Sensor, Temperature and Humidity Sensors. Each sensor signifies a warning level when water reaches maximum level and then temperature and humidity sensor display the live temperature and live humidity level. When the water level sensor, senses critical level, an output values will be send to a microcontroller which serves as a switch that triggers the connected GSM modem to send an alert SMS message, temperature and humidity values to the server. Then, the server will automatically send an alert text message to the numbers stored in the database and result will be displayed in the form of graph with the help of Thingsview Android Application.

The process repeats as the water level continues to rise and triggers another sensor. The main task of sensors is to identify the critical point and send a warning message warning to the nearby areas.

3.1 Working Principle

To collect data of mentioned natural factors the system consist of different sensors which collects data for individual parameters. For detecting changes in humidity and temperature the system has a DHT11 Digital Temperature Humidity Sensor which is an advanced sensor module with consists of resistive humidity and temperature detection components. The water level is always under observation by a float sensor, which works by opening and closing circuits (dry contacts) as water levels rise and fall. It normally rest in the closed position, meaning the circuit is incomplete and no electricity is passing through the wires yet. Once the water level drops below a predetermined point, the circuit completes itself and sends electricity through the completed circuit to trigger an alarm. The flow sensor on the system keeps eye on the flow of water. The water flow sensor consists of a plastic valve body, a water rotor, and a hall-effect sensor. When water flows through the rotor, rotor rolls. Its speed changes with different rate of flow.

3.2 Pseudo Code of Proposed Method

Table 1. Water Flood Detection Algorithm

Procedure Water Flood Detection Algorithm (WFDA)

Assume that Water Level Detection Sensor, Temperature and Humidity Sensors are fixed near the water body.

Let "W" be the water body
Let "WL" be the Water Level
Let "T" be the Temperature
Let "H" be the Humidity

Begin
Monitor the values of W, WL, T, and H regularly
IF (WL>MAX LEVEL) THEN
"Send Alert Message" // sends SMS to all the registered users //
ELSE (Send Temperature level and Humidity Level)
// Normal Value is transmitted to the users which indicates that there is no flood //

IV. SIMULATION PALTFORM

This section shows the simulation environment of the proposed system both in terms of hardware and software requirements. In IoT technology, both hardware and software technology palys a major role.

A. Hardware Requirements

The hardware requirements serve as the basics for the implementation of the system which must be complete and consistent specification of the whole system.

1. AT MEGA 328 Micro Controllers

A microcontroller is a small computer on a single integrated circuit as shown in figure 2. In modern terminology it is similar to a System on Chip (SoC). SoC

may include a microcontroller as one of its components. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems. In the context of the internet of things, microcontrollers are an economical and popular means of data collection, sensing and actuating the physical world as edge devices[16].

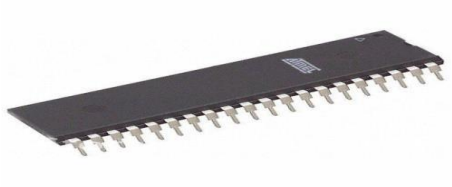

Figure 2. Microcontroller

2. GSM MODEM

A GSM (Global System for Mobile communication) modem is a device which can be either a mobile phone or a modem device used to make a computer or any other processor communicate over a network. It requires a SIM card to be operated and operates over a network range subscribed by the network operator. GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the rate of 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. Figure 3 shows the architecture of GSM Modem [17].

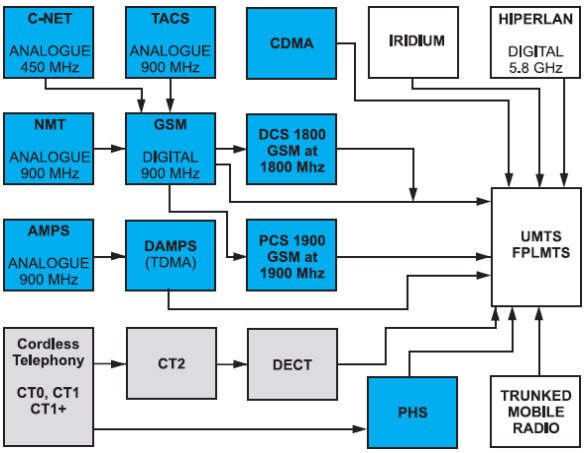

Figure 3. GSM Modem

3. Liquid–Crystal Display (LCD)

It is a flat-panel display or other electronic visual display that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and signage. Fig.4 shows LCD Display [18].

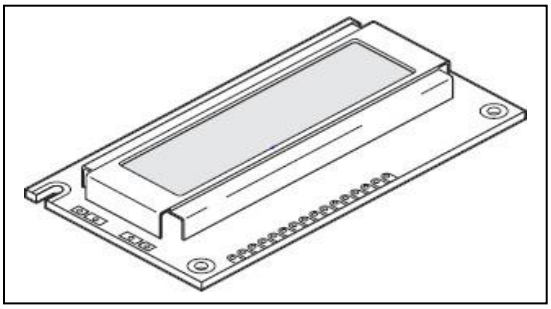

Figure 4. LCD Display

4. Water Level Detection Sensor

Water Level Detection Sensor shown in Figure 5, detects the level of liquids and other fluids and fluidized solids, including slurries, granular materials, and powders that exhibit an upper free surface. Substances that flow become essentially horizontal in their containers (or other physical boundaries) because of gravity whereas most bulk solids pile at an angle of repose to a peak. The substance to be measured can be inside a container or can be in its natural form (e.g., a river or a lake). The level measurement can be either continuous or point values. Continuous level sensors measure level within a specified range and determine the exact amount of substance in a certain place, while point-level sensors only indicate whether the substance is above or below the sensing point. Generally the latter detect levels that are excessively high or low [19].

Figure 5. Water Level Detection Sensor

5. Temperature and Humidity Sensor

DHT11 Sensor can measure humidity value in the range of 20 – 90% of Relative Humidity (RH) and a temperature in the range of 0 – 50^0C. The sampling period of the sensor is 1 second. All the DHT11 Sensors are accurately calibrated in the laboratory and the results are stored in the memory. This Sensor, which generates calibrated digital output. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low cost humidity and temperature sensor which provides high reliability and long term stability [20]. This work builds a small circuit to interface Arduino with DHT11 Temperature and Humidity Sensor. One of the main applications of connecting DHT11 sensor with Arduino is weather monitoring. Figure 6 shows DHT11 Sensor.

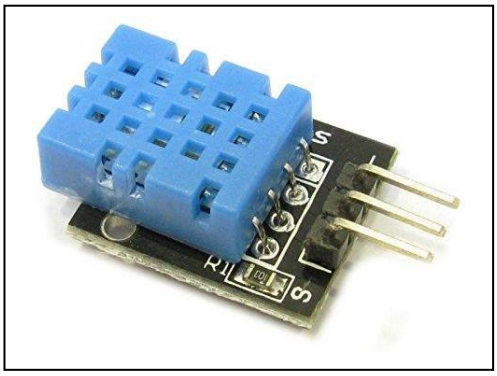

Figure 6. DHT11 Sensor

B. Software Requirements

1. ARDUINO IDE

Arduino IDE is open source software that is mainly used for writing and compiling the code into the Arduino Module. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards as shown in Figure 7.

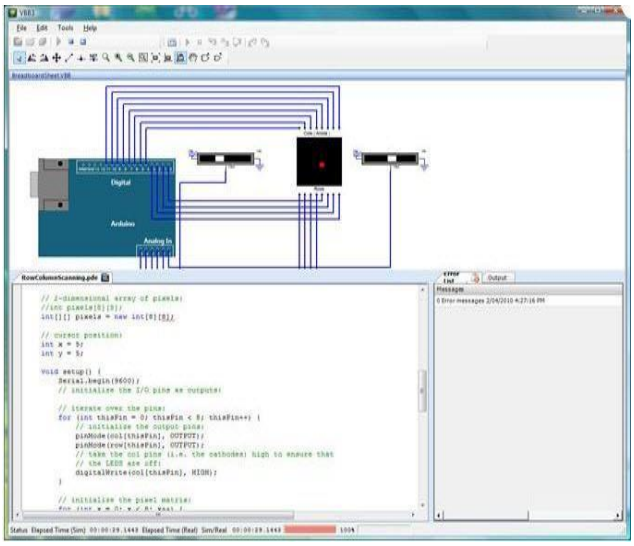

Figure 7. ARDUINO IDE

2. Thingview Android Application

Thingview enables the user to visualize ThingSpeak channels in an easy way. ThingSpeak is an open source "Internet of Things" platform to store and retrieve data from things using HTTP over internet as shown in Fig. 8. With ThingSpeak you can create sensor logging applications, location tracking applications, and a social network of things with status updates. For public channels the application will respect your windows settings: color, timescale, chart type and number of results. The current version supports line and column charts, the spline charts are displayed as line charts. For private channels, the data will be displayed using the default settings, as there is no way to read the private windows settings with the api keyonly[21] [22].

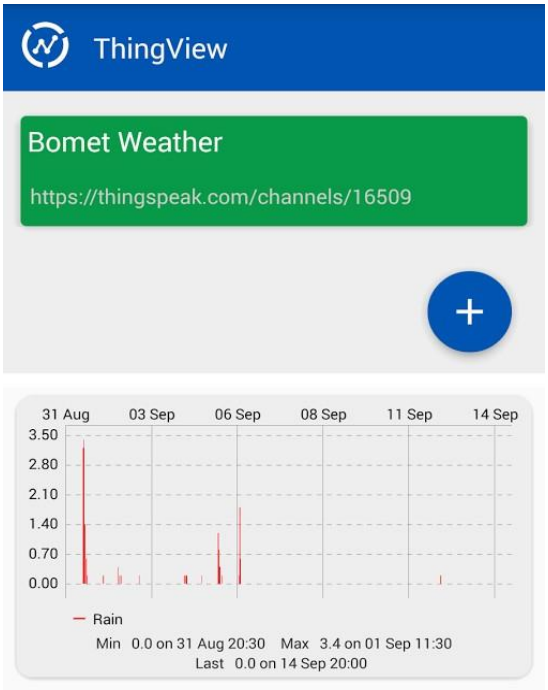

Figure 8. ARDUINO IDE

V. RESULTS AND DISCUSSION

This section shows the resutls of the proposed method. The proposed method uses different Quality of Service (QoS) metrics such as security, relaibility, maintainability and usability to measure perfromance.

A. Performance Metrics

Table 1. Performance Metrics

Metrics	Low	Medium	High
Security	×	×	√
Reliability	×	×	√
Maintainability	×	×	√
Usability	×	×	√

The strategic implementation process is the concrete steps that turns strategic plan into the actions to accomplish goals and objectives. Table 1 shows the performance metrics considered in this paper.

- Security: Security is the most important factor to communicate the message with others. Security is assured by validating the user before transmitting the message.
- Reliability: Reliability is measured as a probability that a system will be able to perform its function over a specified time interval with any loss or delay.
- Maintainability: software maintenance refers to the modification made to the system to meet the new requirements.

- Usability: Usability defines how well the proposed system meets the requirements of the user by using the easy end-to-end connectivity results in a good experience.

B. Results and Analysis

The proposed method in this paper retrieves the information from the sensor by searching the values from water body at any point of time.

The following are the four major steps for implementation:

A. Connection of sensors and GSM Modem

This is the first step of the implementation process through which the power supply will be send to the GSM modem to accelerate the Microcontroller. Figure 9 and Figure 10 shows connecting sensor and GSM Modem and Internet connected process.

- Once the power is on, the sensor starts to detect the values.
- The GSM modem is searching for internet connection and the values from the sensor will be collected by microcontroller and send the data to the GSM modem.

Figure 9. Connecting Sensor and GSM Modem

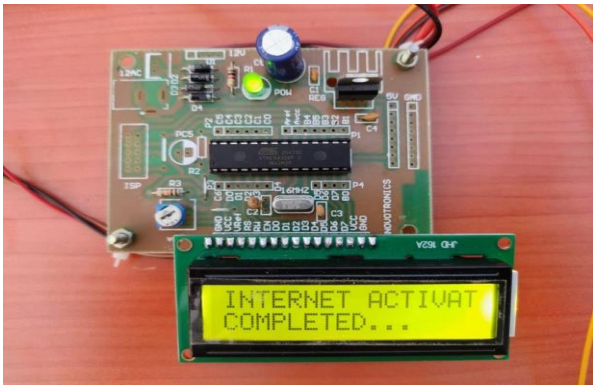

Figure 10. Internet Connected

B. Fetching the data from the sensor

Figure 11 shows the process of fetching data from sensor. When the power supplied to the sensor it starts to measure the values of the water level, live temperature and live humidity.

- Once the values measured by the sensor, and that values will be send to the microcontroller.
- The microcontroller checks the code to send the text message to the available mobile numbers which is stored in the database of microcontroller. Finally the data will be send to GSM modem.

Figure 11. Fetching data from sensor

C. Updating the data from sensor to LCD and Thingview Application

Once the data will be collected from the sensor it will be send to the microcontroller and it will be updated to the LCD.

The data will be collected from the sensor are send to the microcontroller and those will be updated on the LCD as shown in Figure 12. Then the data will be sends to cloud to view the data in the Thingview.

Figure 12. Updating values in LCD

D. SMS Process

From this the bulk SMS to the mobile phone where the number will be stored in the microcontroller and the data which is now stored in the cloud be send a SMS alert message whether a water reaches the critical level. When a water level increases it will automatically send the SMS to the mobile numbers which is stored in the database in the microcontroller. Figure 13 shows the SMS process.

The internet connection will be high so that the data will be updated fast to the thingview application and the user will view the daily flow graph from anywhere.

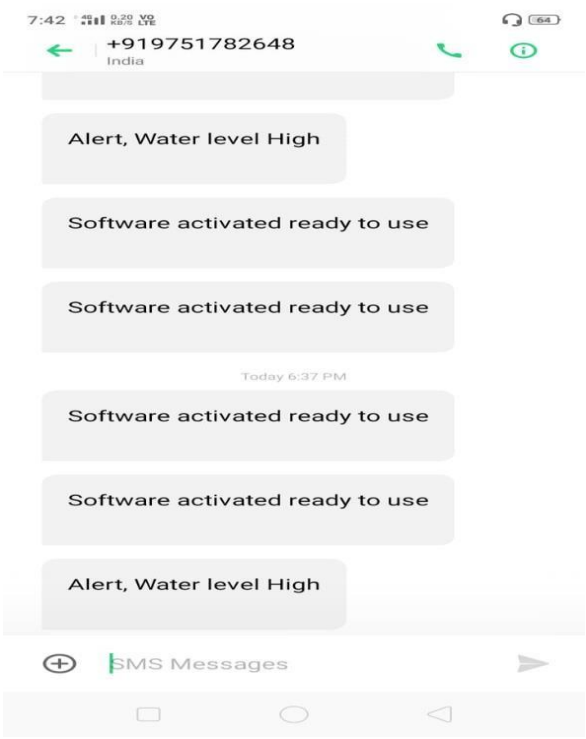

Figure 13. SMS Process

VI. CONCLUSION

This paper contributes towards to work for the society in case of severe water flood situation in several water bodies. It envisions a safe, prepared and less casualty community before, during and after typhoon devastation. The proposed model uses the real- time monitoring system through the developed IOT technology and SMS notification system as an easy medium in disseminating information particularly in the remote areas. Finally, the developed flood monitoring and early warning system utilizes water level sensor to detect water level, functions perfectly according to the specification provided. It successfully passed several tests based on the different parameters. The flood alert information's can be displayed on LED display boards for road users and for safety reasons could be placed at strategic locations. Such information's should be in real time and transmitted wirelessly from the measured location.

In future, extend the proposed method for large water bodies in real time with different performance metrics. To provide additional features such as: User activities, status when changed.

REFERENCES

[1]. Zahir, Shahirah Binti, et al. "Smart IoT Flood Monitoring System." *Journal of Physics: Conference Series*. Vol. 1339. No. 1. IOP Publishing, 2019.

[2]. Priya, S. Jana, et al. "Flood monitoring and alerting system." *International Journal of Computer Engineering & Technology (IJCET)* 8.2 (2017): 15.

[3]. Hughes, Danny, et al. "An intelligent and adaptable grid-based flood monitoring and warning system." *Proceedings of the UK eScience All Hands Meeting*. Vol. 10. 2006.

[4]. Fowdur, Tulsi Pawan, et al. "Performance analysis and implementation of an adaptive real-time weather forecasting system." *Internet of Things* 3 (2018): 12-33.

[5]. Thielen, Jutta, et al. "The European Flood Alert System-Part 1: Concept and development." *Hydrology & Earth System Sciences* 13.2 (2009).

[6]. H. McMillan, J. Freer, F. Pappenberger, T. Krueger, and M. Clark, "Impacts of uncertain river flow data on rainfall-runoff model calibration and discharge predictions," Hydrological Processes, vol. 24, no. 10, 2010, pp. 1270–1284.

[7]. F. Pappenberger et al., "Visualizing probabilistic flood forecast information: expert preferences and perceptions of best practice in uncertainty communication," Hydrological Processes, vol. 27, no. 1, 2013, pp. 132– 146.

[8]. M. Ancona et al., "On the design of an intelligent sensor network for flash flood monitoring, diagnosis and management in urban areas position paper," Procedia Computer Science, vol. 32, 2014, pp. 941– 946.

[9]. M. Borga, E. Gaume, J. D. Creutin, and L. Marchi, "Surveying flash floods: gauging the ungauged extremes," Hydrological processes, vol. 22, no. 18, 2008, p. 3883.

[10]. E. Gertz and P. Di Justo, Environmental Monitoring with Arduino. O'Reilly,2013.

[11]. Sadeka Sultana, TawhidaAkand, MrinmoyDey "Design and implementation of Flood detection security system using Node MCU" 2016 9th International Conference on Electrical and Computer Engineering (ICECE), 20-22 Dec. 2016, DOI:10.1109/ICECE.2016.7853980, IEEEXplore.

[12]. Nikolay N. Bakin,Vasiliy I. Tuyev, Eduard F. Yauk "Arduino IDE" 2011 International Conference and Seminar on Micro/Nanotechnologies and Electron Devices Proceedings, 30 June-4 July 2011, DOI:10.1109/EDM.2011.6006944. ISSN: 1815-3712, IEEEXplore.

[13]. R. Vajeth, D. Dama,"IoT based flood detection using ultrasonic sensor", 2004 IEEE Africon. 7th Africon Conference in Africa, DOI: 10.1109/AFRICON.2004.1406747,INSPEC Accession Number: 8304644, IEEE Xplore.

[14]. Carlos M. S. Rodrigues, Bruno S. L. Castro, "A Vision of Internet of Things In industry 4.0 With Esp8266" International Journal of Electronics and Communication Engineering and Technology, January- February 2018, ISSN Print: 0976-6464 and ISSN Online: 0976-6472,IAEME.

[15]. Ganguly, S. SAR "Paper Battery-A Promising Energy Solution for India" International Journal of Advanced Engineering Research and Studies, E-ISSN2249 – 8974, ResearchPaper.

[16]. Lee Li ; Liu Gang ,Zeng Han ; Hu Guan , Liu Ning ; Cai Li ,Lin Fuchang, "Design, Construction, and Testing of Switches and Trigger Generator for 1.2-MJ Capacitive Pulsed Power Supply Module" IEEE Transactions on Plasma Science, 09 November 2010, DOI: 10.1109/TPS.2010.2078521, IEEEXplore.

[17]. Simatupang, Joni Welman, and Faiz Naufal. "Flood Early Warning Detection System Prototype Based on IoT Network." *Internetworking Indonesia Journal* 11 (2019): 17-22.

[18]. Souza, Alisson Silva, et al. "A flood warning system to critical region." *Procedia Computer Science* 109 (2017): 1104-1109.

[19]. Chowdury, Mohammad Salah Uddin, et al. "IoT based real-time river water quality monitoring system." *Procedia Computer Science* 155 (2019): 161-168.

[20]. Udo, Edward N., and Etebong B. Isong. "Flood monitoring and detection system using wireless sensor network." *Asian journal of computer and information systems* 1.04 (2013).

[21]. S. Sabeena, M. Jaganathan, " A vision of Internet of Things", International Journal of Computer Sciences and Engineering", vol. 7, issue-2, page no. 492-497, Feb-2019.

[22]. N.S. Sanguida, M. Sasikala, "A Study on Internet of Things", International Journal of Computer Sciences and Engineering", Vol.7, Issue 4, Feb 2019.

